

Lost and found – Fritz Müller’s type material of *Glossiphonia verrucata* (Fr. Müller, 1844) (Hirudinida, Glossiphoniidae) with notes on the leech fauna of lake Tegel in Berlin (Germany)

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Abstract

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In 1844, the famous German biologist Fritz Müller published his dissertation about the leech fauna of lakes in Berlin. This study not only addressed the occurrence of leeches in the different lakes, but also contains the description of a new species - *Glossiphonia verrucata* (Fr. Müller, 1844). Unfortunately, he never mentioned how many specimens he found and where he deposited the material of his dissertation research. Thus, it came as a surprise that the material appeared in the small leech collection of the Zoological Museum of the University of Greifswald. Here, we provide an overview of the material focusing especially on the four syntypes of *G. verrucata*. Since this is a rarely found species, we further explored historical material from the type locality, Lake Tegel, held in other museums. Our survey revealed that the material collected by Müller is the only one known to date from the species-rich Lake Tegel, which is inhabited by 14 species of freshwater leeches.

Introduction

The collection of leeches (Hirudinea) of the Zoological Institute and Museum of the University of Greifswald (ZIMG) is considerably small (only 66 specimens), but with 31 taxa the most diverse public collection of leeches in the state Mecklenburg-Vorpommern (Jueg 2015). Nearly all specimens were collected in the 19th century and are in good conditions considering their age. This collection contains the oldest conserved leeches for the state (1834, coll. Creplin), including seven first records and some other non-palearctic species, which are rarely represented in German natural history collections.

As revealed by Jueg (2015), it also contains four specimens of *Glossiphonia verrucata* collected in lake Tegel in Berlin. Unfortunately, the specimen label does not have a collecting date, but it is noted that these specimens were collected and determined by Johann Friedrich Theodor

Müller (1822–1897) better known as Fritz Müller – the famous German naturalist who emigrated 1852 to Blumenau (Brazil). Müller is a well-known early advocate of Darwinism (e.g. Müller 1864) and extensively corresponded with Charles Darwin and also other influential biologists of the 19th century (e.g. Ernst Haeckel). He published nearly 250 articles on life history, morphology, systematics and evolution of plants and animals. The Müllerian mimicry was named after him based on his ground-breaking contributions to the theory of insect mimicry. The life and scientific achievements of this remarkable biologist are summarized in Möller (1915–21) and West (2003, 2016).

Fritz Müller studied mathematics and natural sciences in Berlin finishing 1844 with a dissertation thesis on leeches in the area of Berlin including the redescription of *Clepsine tessulata* (synonym of *Theromyzon tessulatum* (O.F. Müller, 1774)) and *Clepsine marginata* (synonym of *Hemiclepsis marginata* (O.F. Müller, 1774)) as well as the description of

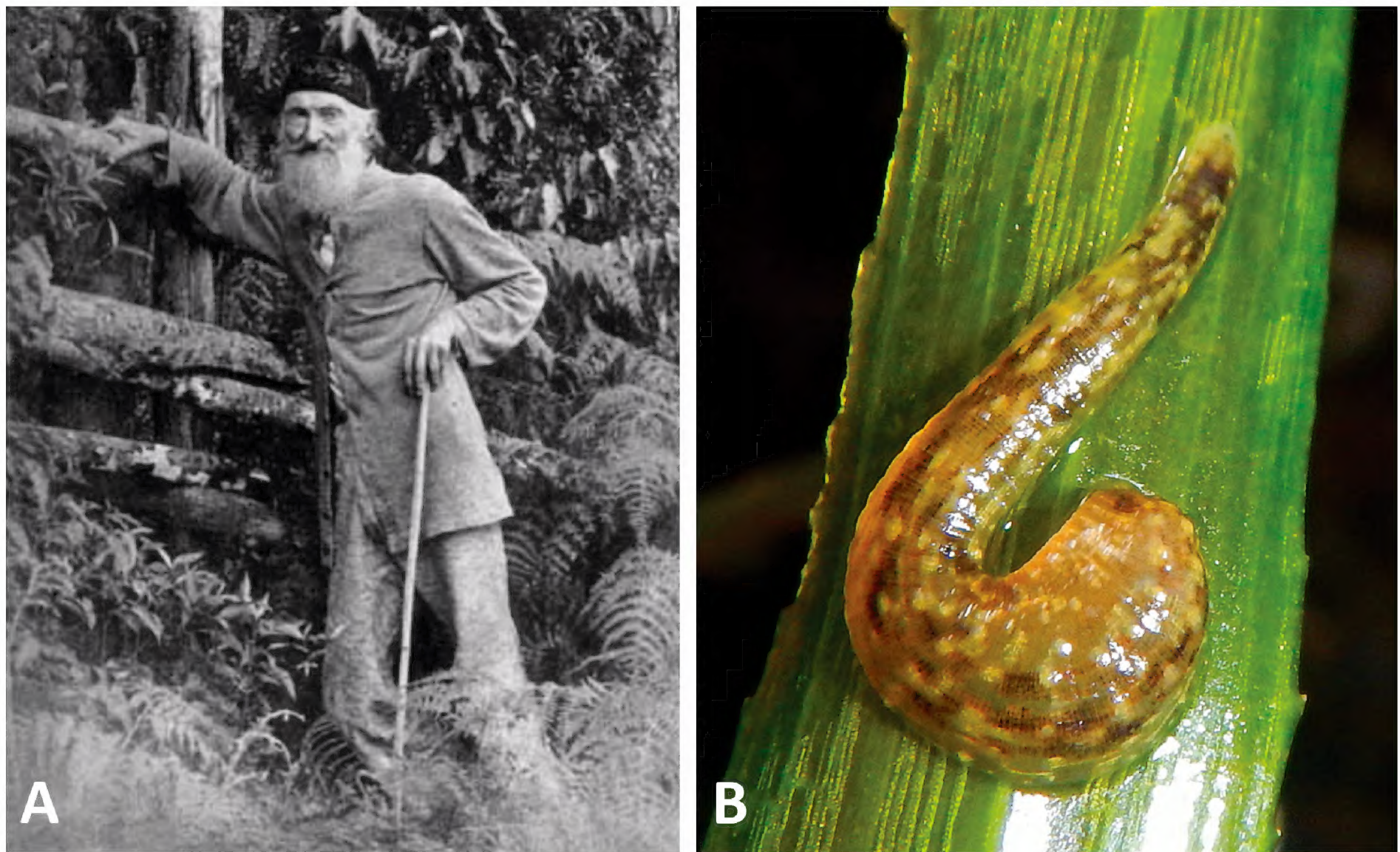


Figure 1. A: The naturalist Fritz Müller in his typical appearance. **B:** Live specimen of *Glossiphonia verrucata* collected in the Krakower Lake (Germany) in 2017.

the new species *Clepsine verrucata* (= *Glossiphonia verrucata* (Fr. Müller, 1844)). According to Jueg (2015), the Museum of Natural History in Berlin (MfN) does not possess any material from Müller’s work on leeches. Furthermore, Müller did not mention where his material was deposited (see Müller 1844) indicating that the material in the collection of the ZIMG could be indeed the type material of Fritz Müller (Jueg 2015). Here, we investigate this collection further by providing an overview of the collection Fr. Müller, revising the type material of *Glossiphonia verrucata* as well as presenting an overview of other historical records from Lake Tegel, which is the type locality of this rare species.

Material and methods

The specimens are kept in 80% ethanol and were examined using a MBC-10 stereomicroscope. Images were taken with the BK PLUS Lab system (Dun Inc.) using a Canon 65 mm macro lens mounted on a Canon 5D Mark II camera. Image stacks were captured with Adobe Lightroom and processed using Zerene Stacker under PMax value. Obtained extended focus images were edited using Adobe Photoshop CS 6. All measurements are given in millimeters.

Results

The leech collection of Fritz Müller at the ZIMG

Among the oldest specimens of the leech collection at the ZIMG are the ones from Fritz Müller, which likely was the basis of his dissertation research. Since the Museum

of Natural History in Berlin does not have any material from Müller, the following specimens seem to be the only ones left from the leech collection of Fritz Müller:

Alboglossiphonia heteroclita (Linnaeus, 1761)

Berlin, Date?, leg. & det. Fr. Müller (det. as *Glossiphonia heteroclita*), rev. U. Jueg, ZIMG II/16225 (7 specimens)

Alboglossiphonia hyalina (O. F. Müller, 1774)

Berlin, 1840, leg. & det. Fr. Müller (det. as *Glossiphonia heteroclita* var. *hyalina*), rev. U. Jueg, ZIMG II/16224 (11 specimens)

Alboglossiphonia “*hyalina*” (n. sp.?)

Berlin, Date?, leg. Fr. Müller (det. as *Glossiphonia heteroclita*), det. U. Jueg, ZIMG II/16225 (8 specimens)

These white specimens are regularly papillated and likely represent a new species, but after the commonly accepted taxonomy we assign these specimens to *Alboglossiphonia hyalina* for now.

Glossiphonia complanata (Linnaeus, 1758)

Mecklenburg-Vorpommern, Greifswald, 1847/1849, leg. & det. Fr. Müller, rev. U. Jueg, ZIMG II/16219a (5 specimens)

Glossiphonia verrucata (Fr. Müller, 1844)

Berlin, Tegeler See, Date?, in 1865 appearance in the catalogue of the ZIMG, leg. & det. Fr. Müller (labelled as *Boreobdella verrucata*), rev. U. Jueg, ZIMG II/16226 (4 specimens, type material, but not labelled as such)

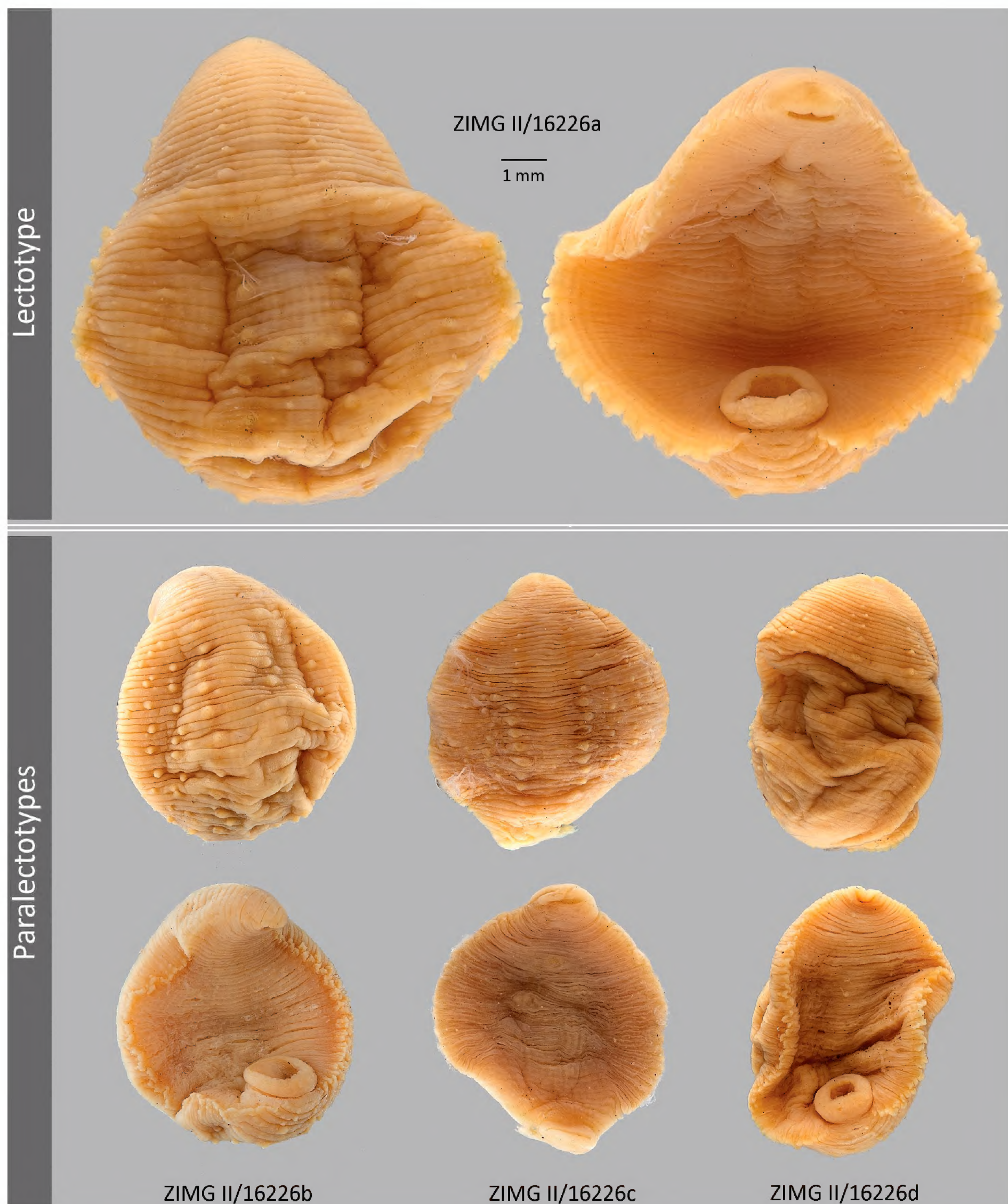


Figure 2. The type specimens of *Glossiphonia verrucata* in dorsal and ventral view.

Hemiclepsis marginata (O. F. Müller, 1774)
Berlin, Date?, leg. & det. Fr. Müller, rev. U. Jueg, ZIMG II/16222 (8 specimens)

Theromyzon tessulatum (O. F. Müller, 1774)
Berlin, Tegeler See, 1847, leg. & det. Fr. Müller (det. as *Protoclepsis tessulata*), rev. U. Jueg, ZIMG II/16233 (2 specimens)

Unfortunately, Müller did not provide very detailed locality information, but seven taxa of the Glossiphoniidae are present in the collection of Müller and thus correspond to his dissertation thesis (he assigned all species to the genus *Clepsine*): *Hemiclepsis marginata*, *Theromyzon tessulatum*, *Glossiphonia verrucata*, *Glossiphonia complanata*, *Alboglossiphonia hyalina*, *Alboglossiphonia heteroclita* and *Helobdella stagnalis*. Based on the descriptions in his thesis, Müller (1844) collected in

several lakes, ponds and rivers in Berlin (e.g. Plötzensee, Grunewaldsee, Spree) and mentioned that *G. verrucata* was very rare and only present in Lake Tegel.

The type material of *Glossiphonia verrucata*

During his revision of the leech material in the natural history collections of Mecklenburg-Vorpommern, Jueg (2015) discovered five historic specimens of *Glossiphonia verrucata* (all labelled as *Boreobdella verrucata*) in the collection of the ZIMG. One specimen was collected by Julius Münter in 1857 in Tribsow (Eastern Pomerania, now Poland; ZIMG II/4287) and four specimens were collected by Fritz Müller in the Lake Tegel in Berlin (Original label: *Boreobdella verrucata*, E lacu Tegliano, Fr. Müller, Acc. Cat. II Nr. 16226). Unfortunately, no collection date was provided, but it was registered in the ZIMG collection catalogue in 1865 explaining the considerable difference between the catalogue numbers of these specimens. Based on the these syntypes, we erected a lectotype (ZIMG II/16226a) and three paralectotypes (ZIMG II/16226b-d).

The four specimen collected by Müller are in good conditions considering its age of over 170 years. They seemed to be immediately fixed in ethanol, which resulted in a strong contraction of the body. Thus, some characters are not or only hardly visible (e.g. sucker and head region). Paralectotype 3 (ZIMG II/16226d) has also a slightly twisted body and all specimens show some deformation in the middle region of the body. In a living stage the animals likely had a body length of 20 to 30 mm. The species characteristics are visible, but vary among the specimens. The color was not retained in the specimens. The typical papillation with an arrangement on the three annulae of each segment is clearly visible. The typical arrangement and number of

the eyes can be seen in one specimen – the reduction to four eyes was already pointed out by Müller (1844). The typical margin of the body is clearly visible in three specimens. Based on all visible characters, which are summarized in Table 1, all specimen can be clearly assigned to *G. verrucata*.

Historic material of Hirudinida from Lake Tegel

In order to underline the findings of Fritz Müller, we surveyed two further collections (Museum of Natural History in Berlin and Center of Natural History in Hamburg), which host historic material from Lake Tegel. In total, we found 14 species representing 5 families (Table 2) – a remarkable diversity of taxa. The lake contains nearly all common species typical for lakes of this size including *Erpobdella monostriata*, which is characteristic for such habitat. *Hirudo medicinalis* might be not a common element of Lake Tegel, as many smaller lakes are in close relations with Lake Tegel and likely the source for the appearance of this species. *Glossiphonia verrucata* was only found by Fritz Müller as we did not find another individual in the other collections neither it was not reported again from Lake Tegel. Of interest was the material of *G. complanata* as some specimen showed a similar papillation as in *G. verrucata* (MfN Nr. 2879-Q and CeNak Nr. V 12404), which could have led to an incorrect determination. However, the arrangement of the papillae was not as typical as in *G. verrucata* and the color, which would help to clearly assign the specimen to one or the other species, was not retain. Considering the variable morphology of *G. complanata* we did not further investigate these specimens and future studies using molecular markers should address the delimitation of this species.

Table 1. Characteristics of the type specimens of *Glossiphonia verrucata*.

	Lectotype	Paralectotype 1	Paralectotype 2	Paralectotype 3
Length	16.0	15.0	14.0	12.0
Mean width of theurosomes	5.5	5.0	4.8	?
Max. width of the trachelosomes	11.2	9.3	11.2	9.2
Height of theurosomes	3.2	2.5	1.7	?
Height of the trachelosome	4.2	3.9	4.4	2.9
Length of anterior sucker	0.7	0.6	deformed	very contracted
Width of anterior sucker	1.3	1.0	deformed	very contracted
Length of posterior sucker	2.8	2.8	deformed	2.4
Width of posterior sucker	2.8	2.9	deformed	2.4
Colour, dorsal	unicoloured light-brown – beige	unicoloured light-brown – beige	unicoloured light-brown – beige	unicoloured light-brown – beige
	paramedian stripes lightly outlined	–	–	–
Colour, ventral	unicoloured light-brown – beige	unicoloured light-brown – beige	unicoloured light-brown – beige	unicoloured light-brown – beige
Papilla	present in typical arrangement	present in typical arrangement	not prominent, but clear to see	light present in typical arrangement
Margin of the body	irregular serrated	irregular serrated	smooth	slight serrated
Head	slightly bulbous	slightly bulbous	clearly bulbous	not bulbous
Eyes	4 visible	4 visible	6 visible, in typical arrangement	not visible
Others	middle body strong squeezed, especially dorsal	middle body strong squeezed, especially dorsal	particularly squeezed, before posterior sucker slightly tear down	middle body strong squeezed, especially dorsal

Table 2. Historical records from Lake Tegel in Berlin.

Species	Fr. Müller (1844)	Collections		
		Greifswald	Berlin	Hamburg
		1840–1847	1886–1904	1930
Family: Glossiphoniidae				
<i>Alboglossiphonia hyalina</i> (O. F. Müller, 1774)	X	X ?		
<i>Glossiphonia complanata</i> (Linnaeus, 1758)	X (cf.)		X	X
<i>Glossiphonia verrucata</i> (Fr. Müller, 1844)	X	X		
<i>Helobdella stagnalis</i> (Linnaeus, 1758)	X (cf.)		X	
<i>Hemiclepsis marginata</i> (O. F. Müller, 1774)	X	X ?		X
<i>Theromyzon tessulatum</i> (O. F. Müller, 1774)	X	X	X	
Family: Piscicolidae				
<i>Piscicola geometra</i> (Linnaeus, 1758)			X	
<i>Piscicola pojmanskae</i> Bielecki, 1994			X	
<i>Piscicola</i> sp.			X	
Family: Hirudinidae				
<i>Hirudo medicinalis</i> Linnaeus, 1758			(X)	
Family: Haemopidae				
<i>Haemopsis sanguisuga</i> (Linnaeus, 1758)			X	
Family: Erpobdellidae				
<i>Erpobdella octoculata</i> (Linnaeus, 1758)			X	X
<i>Erpobdella testacea</i> (Savigny, 1820)			X	
<i>Erpobdella monostrata</i> (Lindenfeld & Pietruszynski, 1890)			X	
Species total: 14	4 (6?)	2 (4?)	11	3

Table 3. Records from Lake Tegel present in the zoological collection of the CeNak Hamburg (revised by Jueg) and the Museum of Natural History in Berlin (MfN, partly determined and revised by Jueg).

Species	Original label	Coll.-Nr.	Locality	Date	leg.	det.	Comments
Coll. MfN, Berlin							
<i>Glossiphonia complanata</i>	<i>Glossiphonia complanata</i>	1408	Tegel-See	1887	Weltner	Johansson	
<i>Theromyzon tessulatum</i>	<i>Theromyzon tessulatum</i>	1409	Tegel	?	Weltner	Johansson	
<i>Erpobdella octoculata</i>	<i>Herpobdella atomaria octoculata</i>	1411	Tegelsee	?	Weltner	Johansson	
<i>Erpobdella octoculata</i> <i>Helobdella stagnalis</i>	<i>Hirudinea spec.</i>	2877-Q	Tegel-See, an der Unterseite von Brettstücken	25.04.1894	Weltner	Jueg	
<i>Hirudo medicinalis</i>	<i>Hirudo medicinalis</i>	2878-Q	Tegel-See, Vorland, an einem auf dem Boden liegendem Stück Holz	26.04.1904	Weltner	Weltner	
<i>Glossiphonia complanata</i>	<i>Hirudinea spec.</i>	2879-Q	Tegel-See	27.03.1894	Weltner	Jueg	few specimens with „ <i>verrucata</i> -like“ papillation
<i>Erpobdella monostriata</i> <i>Erpobdella testacea</i>	<i>Hirudinea spec.</i>	2880-Q	Tegel-See	27.03.1894	Weltner	Jueg	
<i>Haemopsis sanguisuga</i>	<i>Haemopsis sanguisuga</i>	2881-Q	Tegel-See	27.03.1894	Weltner	Weltner	
<i>Erpobdella octoculata</i>	<i>Hirudinea spec.</i>	2982-Q	Tegel	00.05.1898	Weltner	Jueg	
<i>Theromyzon tessulatum</i>	<i>Theromyzon tessulatum</i>	3527-Q	Tegel	05.06.1887	Weltner	Weltner	
<i>Piscicola pojmanskae</i> <i>Piscicola geometra</i> <i>Piscicola</i> sp. n.	<i>Piscicola geometra</i>	5131 5131 5131	Tegeler See	29.05.1891	Weltner	Bielecki Jueg Bielecki	
<i>Erpobdella octoculata</i>	<i>Herpobdella octoculata</i>	5143	Tegel	?	Weltner	Johansson	
<i>Erpobdella octoculata</i>	<i>Herpobdella vulgaris</i>	9814	Tegel	00.12.1886	Collin	Collin	
<i>Piscicola geometra</i>	<i>Piscicola geometra</i>	11213	Tegel-See, an der Unterseite von Brettstücken	25.04.1894	Weltner	Bielecki	
Coll. CeNak. Hamburg							
<i>Glossiphonia complanata</i>	<i>Clepsine complanata</i>	V 12404	Tegeler See bei Berlin	?	Quelle	Augener	inventory 1935; with „ <i>verrucata</i> -like“ papillation
<i>Hemiclepsis marginata</i>	<i>Hemiclepsis marginata</i>	V 11067	Tegeler See, Berlin	?	Quelle	Augener	inventory 1930
<i>Erpobdella octoculata</i>	<i>Nepheleis octoculata</i>	V 11068	Tegeler See	?	Quelle	Augener	inventory 1930

Discussion

The original description of *Glossiphonia verrucata* can be found in the dissertation thesis „Hirudinibus circa Berolinum hucusque observatis” of Fritz Müller, but without any remark on the number of collected individuals and also on

the fate of the material on which the description is based on (Müller 1844). Thus, it was rather surprising to find a considerable amount of his material in the collection of the ZIMG and that no material is present in the collection of the MfN (Hartwich 1986, Jueg 2015). The reason why the material of Müller is deposited in Greifswald is unclear, but

he likely deposited all his dissertation material in the museum during his time in Greifswald where he studied medicine from 1845 to 1849. Moreover, Fritz Müller was already in contact with the founder and director of the Zoological Museum Greifswald, Christian Friedrich Hornschuch (1793–1850), during his dissertation work as he explicitly mentioned Hornschuch in the acknowledgements (Müller 1844).

The main distribution of *Glossiphonia verrucata* is restricted to the northern Palearctic (Jueg 2013). In Central Europe this species is extremely rare with the exception of the population reported from the river Danube where it was found from Bavaria to Hungary (Nesemann 1997, Nesemann and Neubert 1999). Since 1844, Lake Tegel is often cited as locality for this species (e.g. Johansson 1929, Autrum 1936, Herter 1968, Jueg 2013), but it was not found again since Müller’s study, which is also expressed clearly by Autrum (1936). Considering that *G. verrucata* is only rarely found (e.g. Jueg 2013), we safely assume that the material in the ZIMG is indeed the type material of this species. Thus, it is also negligible that the label of the type material was written later-on (likely with the entry in the catalogue in 1865). Regarding the occurrence of *G. verrucata* in Lake Tegel it is of interest, that Kalbe found one specimen in August 1961 around 25 km south of Lake Tegel in the “Jungferensee” near Potsdam (Kalbe 1965). Both lakes are connected by the river Havel and Kalbe extensively worked in this area studying nearly 3.000 freshwater leeches. Thus, it can be concluded that *G. verrucata* is extremely rare in this area, but likely present in lakes connected by the Havel which should be addressed in future studies.

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